

further. To all appearance they were made up altogether of morainic matter, but in ascending the steep side of one of them I was surprised to find that my feet, after sinking through a few inches of loose stone, struck upon a hard surface of ice, and that the bulk of the ridge was made up of stony ice.

Seeing also that muddy water was welling out in the depression between this ridge and the next, I came to think that a buried portion of the glacier probably still underlay all this ground, perhaps even reaching down to the beach. Then, observing huge piles of similar material on the mountain-side, I concluded that a portion of the ice might remain hidden there also.

If this were so, then the downward pressure of this mass on the one hand against the sloping and partially-buried flank of the glacier on the other would readily explain the presence of these ridges.

This view of their origin is illustrated in the following diagram (Fig. 2), which I drew just after leaving the glacier; it would account for the mixture of water-worn and angular debris in the ridges, the former resulting from the watercourses between the glacier and the mountain, and the latter from the melting of stony ice.



FIG. 2.—Ideal Section across the Moraine on the eastern flank of the Muir Glacier.

- A, Eastern slope of the glacier: stony ice covered with a deep layer of loose stones.
- B, Solid rock of the mountain-side.
- C C C, Ridges apparently consisting of water-worn gravel and sand, with some angular debris, but probably hiding a core of stony ice, D D D.
- D D D, Buried portion of the glacier, supposed to exist below the moraine at C C C, and also on the mountain-side, which has been pressed up into ridges.

The ridges at the time of my visit were about half a mile in length, but may of course grow much longer as the glacier shrinks back. Though more or less regular, they were here and there interrupted and confused so as to form hollows surrounded by mounds, and in one case I noticed that the drainage of a gully had been dammed back so as to form a pond, in which the muddy water deposited much of its fine rock-flour, and issued out comparatively clear at the other side of the obstruction.

The boulders and pebbles of the moraine were chiefly of gray granite, but I noticed also quartzite, gneiss, a few fragments of slaty shale, and a mass of ancient-looking conglomerate—the last-named on the beach. During the day I saw only one scratched block; this was low down on the moraine near the beach.

We were now obliged to join the boat, which was waiting to take us back to the ship, and very much did I regret that circumstances would not permit me to stay longer.

Before leaving the ice-cliffs we fired a shot or two from our small signal cannon, to try to bring about an avalanche, but it had no perceptible effect, and the avalanches continued to choose their own time to fall.

This whole region forms a magnificent field for the study of glacial phenomena, and to any geologist who may follow I would especially say—examine the hollow between the ice and the mountains; go to the foot of the ice-cliff at low water; and, wherever there is stained ice on the top of the glacier, trace out the source of the discolouration.

G. W. LAMPLUGH

#### NOTES

THE honour of knighthood was conferred upon Prof. Robert Stawell Ball, LL.D., Astronomer-Royal for Ireland, at the levee of the Lord-Lieutenant, on January 25.

LORD IDDESLEIGH has selected Mr. D. Morris, Director of the Public Gardens, Jamaica, for the appointment of Assistant Director of the Royal Botanic Gardens at Kew.

DR. RILEY, Entomologist to the United States Agricultural Department, has presented his collection of insects to the United States. It is said to contain 115,000 specimens of 20,000 species or varieties of insects.

THE Committee of the François Arago centenary have appointed M. Mouchez, Director of the Observatory, President; M. Floquet, President of the Chamber of Deputies, has been appointed Honorary President. The principal part of the celebration will take place at the Observatory.

M. PAUL BERT will not leave Paris so soon as was expected for Tonquin; the delay is occasioned by the organisation of the scientific part of his mission.

THE late M. Bertillon has bequeathed a sum of 4000 francs to the Paris Anthropological Society, to found a biennial prize to be awarded for the best work on some anthropological subject.

A SHOCK of earthquake was felt at about 7 o'clock on the morning of January 20 at St. Austell and in the neighbourhood. It appeared as if an explosion had taken place, so great was the noise, and the sound was immediately followed by the shaking of the ground. Persons felt their beds moving under them, and many others had an impression that a portion of their house was falling down. The shock was also felt at Mevagissey. Many people were shaken in their beds. In one instance a clock was stopped, and in many houses the doors and windows shook violently. The inhabitants of St. Blazey and neighbourhood were greatly startled, about a quarter past 7, by hearing a loud rumbling noise and by houses being shaken from foundation to roof. It appeared to come from a northerly direction, and the vibration lasted about 4 or 5 seconds. Persons coming in from the outlying districts and giving an account of the shock being more or less severe all agree as to the time of its taking place.

A TELEGRAM from Mexico states that there was a renewed eruption on January 16 from the Colima volcano. Enormous stones were thrown out, and great streams of lava appeared. The eruption was accompanied by earthquakes.

MR. J. FRANCIS COLE, writing from Sutton, Surrey, informs us that he was a spectator of the remarkable meteor alluded to in our columns of the 21st inst. (p. 278). As seen by him, the meteor appeared to explode or extinguish itself at a point about midway between the horizon and Capella, and was of a form like a well-shaped pear. It seemed so near that he felt he could have hit it with a stone. At the moment of exploding it opened in the centre of the lower part with a well-defined slit, and then widening, showed a light of the character of a hydrogen flame. The direction of the meteor was clearly from west to east, and at the same time the wind was blowing strongly from the west.

AMONGST the objects of interest at the forthcoming Colonial and Indian Exhibition will be a rare collection of indigenous Australian grasses. The specimens are named to correspond with the nomenclature used in the "Flora Australiensis," and there is in addition much practical information about each, derived from general sources.

WE have received Prof. Baird's last Report on the work of the Smithsonian Institution, which deals only with the half year ending June 30 last, in consequence of a resolution of the Board of Regents directing that the fiscal year, instead of extending from January to December, shall, like the Government fiscal year, extend from July 1 to June 30 in future. Amongst the publications promised by the Institution we notice the scientific

writings of Prof. Joseph Henry, which will consist altogether of 1050 printed pages, and which are due now; also a work by Prof. Cope, of Philadelphia, on the reptiles and batrachians of North America. A compact manual on this subject was wanting, although numerous monographs on reptiles have been published, and when this has been completed, the entire field of the vertebrates of North America will have been covered by convenient and effective text-books prepared under the direction of the Institution. The various departments of the museum are treated, as usual, in successive paragraphs describing their work for the year. Under the head of "Explorations" we notice that Mr. Thomas Wilson, United States Consul at Nantes, and afterwards at Nice, has presented a very large collection of the remains of prehistoric man around these two places. It is believed that this collection, filling a large number of boxes, will prove to be one of the richest and most complete ever sent to the United States.

THE idea of an International Exhibition at Geneva has been abandoned, and it is now intended to hold only a national Swiss Exhibition.

A SOUTH AMERICAN Exhibition will be held at Berlin by the Central Verein für Handelsgeographie during May, June, and July, in which Brazilian products will be specially represented.

IN Germany an unusual number of white varieties of animals are noticed this winter. A white chamois was shot in the Totengebirge, a white fish otter was caught near Luxemburg, white partridges were shot near Brunswick, and a white fox was killed in Hessen.

THE recently-formed Central-Swiss Geographico-Commercial Society at Aarau is collecting funds for the erection of an ethnological museum.

IN the new number (No. 15) of the *Journal* of the Straits Branch of the Royal Asiatic Society, Mr. Wheatley, in a paper on the rainfall of Singapore, urges that the Straits Settlements are almost the wealthiest of the British colonies, and that it is not too soon to provide for an Observatory under an astronomer and meteorologist. The equatorial position of Singapore, he adds, would give to the astronomer a more interesting field for observation than can be obtained at higher or lower latitudes. Meanwhile, private observers are doing their best to study the meteorological features of the Straits, and Mr. Wheatley publishes tables of mean annual rainfall and number of rainy days from 1869 to 1884. Mr. Dodd, whose name is given to a conspicuous mountain-range in Northern Formosa, and who has already written on the "aborigines" of that island, describes the hill-tribes in the north, occupying the savage forest-clad mountains to the south-east and south of the town of Banka. These appear to have no negro features whatever; the hair is lank, not curly or frizzled, their lips are not so thick even as those of Malays, and the high noses possessed by many approach often the European type. The complexion, too, of the younger men who had not undergone much hardship or exposure is as light and fair as that of the Japanese. The paper is not finished in this number. The other papers are mainly geographical.

IN a recent paper to the *Archiv für Anthropologie* on the capacity and chief diameters of the skull in different nations, Herr Welcker considers that nine-tenths of all the figures of capacity given in literature are incorrect, most of them being excessive. After discussing different modes of measurement, he gives the following results of his own observations:—In the Germanic peoples the average internal capacity varies between 1400 and 1550 c.cm. In Celts, Romans, and Greeks we find 1400 to 1500; in the Slavs the width of variation is about the same as in the Germans (but less exactly determined). Quite out of the series are the peoples of Hindostan; the narrow range

of 1260 to 1370 includes all the members of this group. Individual examples of the Semitic and Hamitic peoples (of which the author had but few to examine) differ widely; but the Jews and Arabians here take a good position—1450 to 1470 c.cm. The Mongolians range from about 1320 (but mostly 1400) to 1500; 1350 to 1450 seems the proper range of the capacity of the Malays, and only very isolated stocks exceed these limits on both sides. The Papuans and Australians show the averages 1370 and 1320 respectively. The negroes vary between 1300 and 1400. A much lower figure appears for the Bushmen (1244). The Americans, finally, have a wide range; while they are normally between 1300 and 1400, they reach in some of their artificially deformed members a mean value of 1200 and even less. Sexual dimorphism (female skull smaller and flatter) is most pronounced in all civilised peoples.

FROM a study of 650 thunderstorms that occurred in Italy in 1881, Signor Ferrari concludes that every thunderstorm is connected with a barometric, hygrometric, and thermic depression; it is behind the two former, and in front of the last. All three depressions, but especially the two latter, are associated with maxima, which are situated behind the barometric and hygrometric depressions, but before the thermic one. Most of those storms arose in the wide plain of the Po. Coming from west-north-west with a velocity of 30–37½ km. per hour, they passed (in case of their greatest range) with slackening speed over the Apennines in Upper and Middle Italy. For a given moment the thunderstorm has the form of a long narrow band, advancing, with numerous bends outwards and inwards, parallel to itself, and having its various characteristic phenomena most intense along the middle line. The *isohyetes*, or curves of equal rainfall, often take the form of ellipses, whose longer axes coincide with the direction of the storm. The dominant wind-direction is generally parallel to that of propagation of the storm.

THE Penny Science Lectures at the Royal Victoria Hall are about to recommence after the Christmas interval. Lectures have been promised as follows:—Tuesday, February 2, Mr. W. P. Bloxam, "Fire, Fuel, and Illumination"; February 9, Mr. J. M. Thomson, "Dirty Water and how to Cleanse it"; February 16, Prof. George Forbes, "Shooting-Stars and Comets"; February 23, Mr. Wm. Lant Carpenter; March 2, Mr. T. Cunningham Porter, "English Cathedrals"; March 9, Dr. J. A. Fleming, "Niagara."

DR. ALFRED DANIELL'S "Text-book of the Principles of Physics" has been adopted, in Polish translation, by the University of Craców.

A FOURTH edition of Prof. Tyndall's "Six Lectures on Light, delivered in the United States in 1872–73," has been issued by Messrs. Longmans and Co.

THE Council of the City and Guilds of London Institute have received an application from the Board of Technical Education of New South Wales requesting them to forward examination papers in technology to the colony, and award certificates and prizes on the results. This application has been referred to the special committee of the Institute on technological examinations.

AT the forthcoming Indian and Colonial Exhibition the Canadian Government intend to demonstrate the manner in which fish culture is prosecuted in the Dominion, and the various methods adopted in regard thereto will be practically illustrated to the public, and shown together with live specimens of Salmonidæ indigenous to native waters. Canada now possesses about twenty hatcheries, most of which have been constructed since 1873, and worked with the greatest success, whitefish being the chief source of reproduction. Preparations are already being made for the reception of the Canadian exhibits, which will be very numerous, and replete with interest.



LARGE consignments of whitefish and trout ova have arrived at the South Kensington Aquarium from America as a presentation from the Commissioners of that country. In consequence of the success attending the introduction of the first-named fish into this country last year, special attention is to be given to their culture during the present season with a view to their distribution in some of our chief lakes. The National Fish Culture Association have extended their hatchery, and, in order to secure healthy embryos, have adopted the new method, viz. the "under-flow" system, which has been found to incubate the ova at a less rate of mortality than the "overflow" system.

DR. SAMUEL TENNY, the indefatigable investigator of Roman antiquities on and around the Lake of Constance, has now at last succeeded in laying bare the forum of the old Roman city of Brigantium (Bregentz), the so-called "Rhätische Pompeii." It consists of an area on the "Oelrain" inclosed by a wall furnished with roofed halls. There are also the remains of a building with stairs and eight columns, evidently a portico of imposing proportions, besides two gates leading to streets. The remains are unfortunately in a very dilapidated condition, and their total destruction is imminent.

IN the eleven years from 1873 to 1884 the number of lions killed in Algeria was 202, for which a premium of 400*l.* has been paid by the Government. The number of panthers destroyed in the same period is 1214, and the money paid by the Government 720*l.* About 400*l.* has been paid for 1882 hyænas, and 1600*l.* for 27,000 jackals. The large felidæ are almost extirpated principally in the western provinces, and the lion of the desert is fast becoming a myth.

IN the *Transactions* of the Verein für Erdkunde at Halle a writer describes certain cave-dwellings in the province of Saxony. These are occasionally found in loess formations in the Balkan Peninsula (in the Lom Palanka region, for instance), but it is somewhat startling to find them used now in such a cultivated place as Saxony. They are in the neighbourhood of Halberstadt, quite close to the village of Langenstein. Here in a sandstone hill, about a dozen caves have been dug, which are used as dwellings. They have different rooms, light and dark, as well as chimneys, windows, and doors, and are said to be very dry and habitable. The writer of the account, a physician, says that he found the inhabitants quite comfortable, and that some of them had lived there for more than thirty years without suffering from any evil effects to their health.

WE have on our table the following new books:—"Zoological Record," vol. xxi. 1884 ("Zoological Record" Association); "The Definitions of Euclid," by R. Webb (Geo. Bell and Sons); "Organic Chemistry," by H. F. Morley (Churchill); "Elementary Algebra," by Chas. Smith (Macmillan and Co.); "Eminent Naturalists," by Thos. Greenwood (Simpkin and Co.).

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, deposited; two White-billed Parrakeets (*Tanygnathus albirostris*) from Celebes, a Bearded Lizard (*Amphibolurus barbatus*) from Australia, purchased; a Common Otter (*Lutra vulgaris*), British, received in exchange.

### OUR ASTRONOMICAL COLUMN

THE DENSITY OF SATURN'S RING.—M. Poincaré supplies a short note on the stability of Saturn's ring in the November number of the *Bulletin Astronomique*. Laplace had shown that the ring could only be stable if it were divided into several concentric rings revolving at different speeds. M. Tisserand had confirmed this result, and had recognised that a single ring must, in order to exist, possess a much higher density than the

planet, and had calculated the maximum breadth of each elementary ring in terms of its density and mean radius. M. Poincaré has carried this investigation a step further, and shown that if the density of a ring be less than a certain amount, it will, under the influence of the slightest perturbation, no longer break up into a number of narrower rings, but into a great number of satellites, and that if the rings be fluid and turn each as a single piece, the density of the inner ring must be at least  $1/5$ , and of the outer ring  $1/16$  that of the planet. For a ring of very small satellites (not for a fluid-ring, as M. Poincaré erroneously states), Maxwell has shown the condition to be that the density should not exceed  $1/300$  part of that of Saturn.

We do not at present know the actual density of the ring from observation sufficiently accurately to make therefrom any certain inference as to its physical condition. Bessel's determination from the movement of the peri-saturnium of the orbit of Titan gave the reciprocal of the mass of the ring as compared with that of Saturn as 118, which, since the volume of the ring—adopting Bond's value of 40 miles for its thickness—is about  $1/400$  that of the planet, would make its density about  $3\frac{1}{4}$  times greater than the planet's. Bessel's value is, however, clearly too great, as he neglected the influence of the equatorial protuberance of Saturn on the movement of the apsides. Meyer's determination of the secular variation of the line of apsides of Titan, viz.  $d\pi = 1726''\cdot5$ , gives the reciprocal of the mass of the ring as 26700, but from all the six brighter satellites as 1960; the latter value closely agreeing with Tisserand's. It does not, however, seem to have been noticed that even the smallest value for the mass considerably exceeds the highest permissible in accordance with Maxwell's result, since that would make the mass of the rings only  $1/120,000$  part of the planet's, an amount we cannot hope to detect with our present resources.

THE ORBIT OF TETHYS.—Herr Karl Böhlin has recently communicated to the Swedish Academy of Sciences an interesting discussion of the elements of the orbit of Tethys. The observations discussed are those of Sir Wm. Herschel, 1789, reduced by Lamont, Lamont, 1836, Sir J. Herschel, 1835-7, the Bonds, 1848-52, Secchi, 1856, Capt. Jacob, 1857-8, Newcomb and Holden, 1874-5, and Meyer, 1880-1. The elements are calculated for each period of observation, without taking account of perturbations. Herr Böhlin, then specially treating the mean longitude of the epoch, and adopting  $190^{\circ}69812$  as the value of the mean motion, draws up tables of the differences between observation and calculation, and attempts to represent them by an empirical formula. The corrected value of the mean motion is  $190^{\circ}698169$ , almost identical with that found previously by M. Baillaud. Herr Böhlin finds that the annual motion of the peri-saturnium amounts to  $33''$ . M. Baillaud's results and M. Tisserand's investigations had given the value as  $70''$ . The excentricity is found as  $0\cdot00803 \pm 0\cdot00077$ .

THE ORBIT OF IAPETUS.—Prof. Asaph Hall has published a memoir containing a very full discussion of all the observations of Iapetus made at Washington from the mounting of the 26-inch refractor until February 29, 1884. His finally adopted elements are deduced from his own observations made between June 10, 1875, and the above-mentioned date. And in deducing them he has taken account of the perturbations produced by the sun, Iapetus being so distant from its primary that, notwithstanding the distance of Saturn from the sun, these perturbations cannot be neglected. The periodic time of the satellite was found, from a comparison of Herschel's observations in 1789 with the conjunctions observed in 1880 and 1881, to be  $79\cdot3310152$  mean solar days. The adopted mean distance determined by two different methods of observing—one by differences of R.A. and declination, and the other by angles of position and distances, which give very accordant results, is  $515''\cdot5195 \pm 0''\cdot02645$ . The corresponding reciprocal of the mass of Saturn (including the planet, its ring, and its satellites) is  $3481\cdot3 \pm 0\cdot54$ , closely agreeing with that found by Meyer from his observations of the six brightest satellites, viz.  $3482\cdot93 \pm 5\cdot50$ .

A NEW METHOD OF DETERMINING THE AMOUNT OF ASTRONOMICAL REFRACTION.—M. Lœwy proposes to determine refraction by placing a glass prism with silvered faces, forming a double mirror, in front of the object-glass of an equatorial. By means of this arrangement the images of two stars—one at the zenith, and the other near the horizon—can be simultaneously viewed in the field and their distance measured. This distance will be affected by the maximum amount of refraction.